

1 **SECTION 9-33, CONSTRUCTION GEOTEXTILE**
2 **April 5, 2004**

3 This section including title is revised to read:
4

5 **SECTION 9-33, CONSTRUCTION GEOSYNTHETIC**
6 **April 5, 2004**

7 **9-33.1 Geosynthetic Material Requirements**

8 The term geosynthetic shall be considered to be inclusive of geotextiles, geogrids, and
9 prefabricated drainage mats.

10
11 Geotextiles, including geotextiles attached to prefabricated drainage core to form a
12 prefabricated drainage mat, shall consist only of long chain polymeric fibers or yarns
13 formed into a stable network such that the fibers or yarns retain their position relative to
14 each other during handling, placement, and design service life. At least 95 percent by
15 weight of the material shall be polyolefins or polyesters. The material shall be free from
16 defects or tears. The geotextile shall also be free of any treatment or coating which
17 might adversely alter its hydraulic or physical properties after installation.
18

19 Geogrids shall consist of a regular network of integrally connected polymer tensile
20 elements with an aperture geometry sufficient to permit mechanical interlock with the
21 surrounding backfill. The long chain polymers in the geogrid tensile elements, not
22 including coatings, shall consist of at least 95 percent by mass of the material of
23 polyolefins or polyesters. The material shall be free of defects, cuts, and tears.
24

25 Prefabricated drainage core shall consist of a three dimensional polymeric material with
26 a structure that permits flow along the core laterally, and which provides support to the
27 geotextiles attached to it.
28

29 The geosynthetic shall conform to the properties as indicated in Tables 1 through 8 in
30 Section 9-33.2, and additional tables as required in the Special Provisions for each use
31 specified in the Plans. Specifically, the geosynthetic uses included in this section and
32 their associated tables of properties are as follows:
33

Geotextile Application	Applicable Property Tables
Underground Drainage, Low Survivability, Classes A, B, and C	Tables 1 and 2
Underground Drainage, Moderate Survivability, Classes A, B, and C	Tables 1 and 2
Separation	Table 3
Soil Stabilization	Table 3
Permanent Erosion Control, Moderate Survivability, Classes A, B, and C	Tables 4 and 5
Permanent Erosion Control, High Survivability Classes A, B, and C	Tables 4 and 5

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2	Ditch Lining	Table 4
3		
4	Temporary Silt Fence	Table 6
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6	Permanent Geosynthetic Retaining Wall	Tables 7 and 9
7		
8	Temporary Geosynthetic Retaining Wall	Tables 7 and 10
9		
10	Prefabricated Drainage Mat	Table 8

11
12 Tables 9 and 10 will be included in the Special Provisions.

13
14 Geogrid and geotextile reinforcement in geosynthetic retaining walls shall conform to
15 the properties specified in Table 9 for permanent walls, and Table 10 for temporary
16 walls.

17
18 For geosynthetic retaining walls that use geogrid reinforcement, the geotextile material
19 placed at the wall face to retain the backfill material as shown in the Plans shall conform
20 to the properties for Construction Geotextile for Underground Drainage, Moderate
21 Survivability, Class A.

22
23 Thread used for sewing geotextiles shall consist of high strength polypropylene,
24 polyester, or polyamide. Nylon threads will not be allowed. The thread used to sew
25 permanent erosion control geotextiles, and to sew geotextile seams in exposed faces of
26 temporary or permanent geosynthetic retaining walls, shall also be resistant to
27 ultraviolet radiation. The thread shall be of contrasting color to that of the geotextile
28 itself.

29 30 **9-33.2 Geosynthetic Properties**

31 32 **9-33.2(1) Geotextile Properties**

33 **Table 1:** Geotextile for underground drainage strength properties for survivability.

34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52	Geotextile Property	Test Method ²	Geotextile Property Requirements ¹	
			Low	Moderate
			Survivability	Survivability
	Grab Tensile Strength, min. in machine and x-machine direction	ASTM D4632	Woven/Nonwoven 180 lbs./115 lbs. min.	Woven/Nonwoven 250 lbs./160 lbs. min.
	Grab Failure Strain, in machine and x-machine direction	ASTM D4632	<50%/≥50%	<50%/≥50%
	Seam Breaking Strength	ASTM D4632 ³	160 lbs./100 lbs. min.	220 lbs./140 lbs. min.
	Puncture Resistance	ASTM D4833	67 lbs./40 lbs. min.	80 lbs./50 lbs. min.
	Tear Strength, min. in machine and x-machine	ASTM D4533	67 lbs/40 lbs. min.	80 lbs./50 lbs. min.

direction

Ultraviolet (UV) Radiation stability	ASTM D4355	50% strength retained min., after 500 hrs. in weatherometer	50% strength retained min., after 500 hrs. in weatherometer
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Table 2: Geotextile for underground drainage filtration properties.

Geotextile Property	Test Method ²	Geotextile Property Requirements ¹		
		Class A	Class B	Class C
AOS	ASTM D4751	.43 mm max. (#40 sieve)	.25 mm max. (#60 sieve)	.18 mm max. (#80 sieve)
Water Permittivity	ASTM D4491	.5 sec ⁻¹ min.	.4 sec ⁻¹ min.	.3 sec ⁻¹ min.

Table 3: Geotextile for separation or soil stabilization.

Geotextile Property	Test Method ²	Geotextile Property Requirements ¹	
		Separation Woven/Nonwoven	Soil Stabilization Woven/Nonwoven
AOS	ASTM D4751	.60 mm max. (#30 sieve)	.43 mm max. (#40 sieve)
Water Permittivity	ASTM D4491	.02 sec ⁻¹ min.	.10 sec ⁻¹ min.
Grab Tensile Strength, min. in machine and x-machine direction	ASTM D4632	250 lbs./160 lbs. min.	315 lbs./200 lbs. min.
Grab Failure Strain, in machine and x-machine direction	ASTM D4632	<50%/≥50%	<50%/≥50%
Seam Breaking Strength	ASTM D4632 ²	220 lbs./140 lbs. min.	270 lbs./180 lbs. min.
Puncture Resistance	ASTM D4833	80 lbs./50 lbs. min.	112 lbs./79 lbs. min.
Tear Strength, min. in machine and x-machine direction	ASTM D4533	80 lbs/50 lbs. min.	112 lbs./79 lbs. min.
Ultraviolet (UV) Radiation stability	ASTM D4355	50% strength retained min., after 500 hrs. in weatherometer	50% strength retained min., after 500 hrs. in weatherometer

Table 4: Geotextile for permanent erosion control and ditch lining.

Geotextile Property Requirements ¹	
Permanent Erosion Control	Ditch Lining
Moderate Servicability	High Servicability

Geotextile Property	Test Method ²	Woven/Nonwoven	Woven/Nonwoven	Woven/Nonwoven
AOS	ASTM D4751	See Table 5	See Table 5	.60 mm max (#30 sieve)
Water Permittivity	ASTM D4491	See Table 5	See Table 5	.02 sec ⁻¹ min.
Grab Tensile Strength, min. in machine and x-machine direction	ASTM D4632	250 lbs./160 lbs. min.	315 lbs./200 lbs. min.	250 lbs./160 lbs. min.
Grab Failure Strain, in machine and x-machine direction	ASTM D4632	15%-50%/≥50%	15%-50%/≥50%	<50%/≥50%
Seam Breaking Strength	ASTM D4632 ²	220 lbs./140 lbs. min.	270 lbs./180 lbs. min.	220 lbs./140 lbs. min.
Burst Strength	ASTM D3785	400 pse/190 psi min.	500 psi/320 psi min.	
Puncture Resistance	ASTM D4833	80 lbs./50 lbs. min.	112 lbs./79 lbs. min.	80 lbs./50 lbs. min.
Tear Strength, min. in machine and x-machine direction	ASTM D4533	80 lbs/50 lbs. min.	112 lbs./79 lbs. min.	80 lbs./50 lbs. min.
Ultraviolet (UV) Radiation stability	ASTM D4355	70% strength retained min., after 500 hrs. in weatherometer	70% strength retained min., after 500 hrs. in weatherometer	70% strength retained min., after 500 hrs. in weatherometer

Table 5: Filtration properties for geotextile for permanent erosion control.

Geotextile Property	Test Method ²	Geotextile Property Requirements ¹		
		Class A	Class B	Class C
AOS	ASTM D4751	.43 mm max. (#40 sieve)	.25 mm max. (#60 sieve)	.22 mm max. (#70 sieve)
Water Permittivity	ASTM D4491	.7 sec ⁻¹ min.	.4 sec ⁻¹ min.	.2 sec ⁻¹ min.

Table 6: Geotextile for temporary silt fence.

Geotextile Property	Test Method ²	Geotextile Property Requirements ¹	
		Unsupported Between Posts	Supported Between Posts with Wire or Polymeric Mesh
AOS	ASTM D4751	.60 mm max. for slit film wovens (#30 sieve) .30 mm max. for all other geotextile types (#50 sieve) .15 mm min. (#100 sieve)	.60 mm max. for slit film wovens (#30 sieve) .30 mm max. for all other geotextile types (#50 sieve) .15 mm min. (#100 sieve)
Water Permittivity	ASTM D4491	.02 sec ⁻¹ min.	.02 sec ⁻¹ min.
Grab Tensile Strength, min. in machine and x-machine direction	ASTM D4632	180 lbs. min. in machine direction, 100 lbs. min. in x-machine direction	100 lbs. min.

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Grab Failure Strain, in machine and x-machine direction	ASTM D4632	30% max. at 180 lbs. or more	
Ultraviolet (UV) Radiation stability	ASTM D4355	70% strength retained min., after 500 hrs. in weatherometer	70% strength retained min., after 500 hrs. in weatherometer

¹All geotextile properties in Tables 1 through 6 are minimum average roll values (i.e., the test result for any sampled roll in a lot shall meet or exceed the values shown in the table).

²The test procedures used are essentially in conformance with the most recently approved ASTM geotextile test procedures, except for geotextile sampling and specimen conditioning, which are in accordance with WSDOT Test Methods 914 and 915, respectively. Copies of these test methods are available at the State Materials Laboratory in Tumwater.

³With seam located in the center of 8-inch long specimen oriented parallel to grip faces.

9-33.2(2) Geosynthetic Properties For Retaining Walls and Reinforced Slopes

All geotextile properties provided in Table 7 are minimum average roll values. The average test results for any sampled roll in a lot shall meet or exceed the values shown in the table. The test procedures specified in the Table are in conformance with the most recently approved ASTM geotextile test procedures, except for geotextile sampling and specimen conditioning, which are in accordance with WSDOT Test Methods 914 and 915, respectively.

Table 7: Minimum properties required for geotextile reinforcement used in geosynthetic reinforced slopes and retaining walls.

Geotextile Property Requirements		
Geotextile Property	Test Method	Woven/Nonwoven
Water Permittivity	ASTM D4491	.02 sec. ⁻¹ min.
AOS	ASTM D4751	.84 mm max. (No. 20 Sieve)
Grab Tensile Strength, min. in machine and x-machine direction	ASTM D4632	200 lbs/120 lbs min.
Grab Failure Strain, in machine and x-machine direction	ASTM D4632	< 50% / ≥ 50%
Seam Breaking Strength ¹	ASTM D4632	160 lbs/100 lbs min.

Puncture Resistance	ASTM D4833	63 lbs/50 lbs min.
Tear Strength, min. in machine and x-machine direction	ASTM D4533	63 lbs/50 lbs min.
Ultraviolet (UV) Radiation Stability	ASTM D4355	70% (for polypropylene and polyethyelene) and 50% (for polyester) Strength Retained min., after 500 Hr. in weatherometer

¹Applies only to seams perpendicular to the wall face.

The ultraviolet (UV) radiation stability, ASTM D4355, shall be a minimum of 70% strength retained after 500 hours in the weatherometer for polypropylene and polyethylene geogrids and geotextiles, and 50% strength retained after 500 hours in the weatherometer for polyester geogrids and geotextiles.

9-33.2(3) Prefabricated Drainage Mat

Prefabricated drainage mat shall have a single or double dimpled polymeric core with a geotextile attached and shall meet the following requirements:

Table 8: Minimum properties required for prefabricated drainage mats.

Property	Test Method	Prefabricated Drainage Material/Geotextile Property Requirements
Width		12 inches min.
Thickness	ASTM D 5199	0.4 inches min.
Compressive Strength at Yield	ASTM D 1621	100 psi min.
In Plan Flow Rate Gradient = 0.1, Pressure = 5.5 psi	ASTM D 4716	5.0 gal. /min./ft.
Gradient = 1.0, Pressure = 14.5 psi		15.0 gal. /min./ft.
Geotextile - AOS	ASTM D 4751	#60 US Sieve max.
Geotextile - Permittivity	ASTM D 4491	> 0.4 SEC ⁻¹
Geotextile - Grab Strength	ASTM D 4632	Nonwoven - 110 lb. min.

Prefabricated drainage mats will be accepted based on the manufacturer's certificate of compliance that the material furnished conforms to these specifications. The Contractor

1 shall submit the manufacturer's certificate of compliance to the Engineer in accordance
2 with Section 1-06.3.

3 4 **9-33.3 Aggregate Cushion of Permanent Erosion Control Geotextile**

5 Aggregate cushion for permanent erosion control geotextile, Class A shall meet the
6 requirements of Section 9-03.9(2). Aggregate cushion for permanent erosion control
7 geotextile, Class B or C shall meet the requirements of Section 9-03.9(3) and 9-03.9(2).

8 9 **9-33.4 Geosynthetic Approval and Acceptance**

10 11 **9-33.4(1) Source Approval**

12 The Contractor shall submit to the Engineer the following information regarding each
13 geosynthetic proposed for use:

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15 Manufacturer's name and current address,
16 Full product name,
17 Geotextile structure, including fiber/yarn type,
18 Geosynthetic polymer type(s) (for temporary and permanent geosynthetic retaining
19 walls), and
20 Proposed geotextile use(s).

21
22 If the geosynthetic source has not been previously evaluated, or is not listed in the
23 current WSDOT Qualified Products List (QPL), a sample of each proposed geosynthetic
24 shall be submitted to the State Materials Laboratory in Tumwater for evaluation. After
25 the sample and required information for each geosynthetic type have arrived at the
26 State Materials Laboratory in Tumwater, a maximum of 14 calendar days will be
27 required for this testing. Source approval will be based on conformance to the
28 applicable values from Tables 1 through 8 in Section 9-33.2 and additional tables as
29 specified in the Special Provisions. Source approval shall not be the basis of
30 acceptance of specific lots of material unless the lot sampled can be clearly identified
31 and the number of samples tested and approved meet the requirements of WSDOT
32 Test Method 914.

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34 Geogrid and geotextile products that are qualified for use in permanent geosynthetic
35 retaining walls and reinforced slopes (Classes 1, 2, or both) are listed in the current
36 WSDOT QPL.

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38 For geogrid and geotextile products proposed for use in permanent geosynthetic
39 retaining walls or reinforced slopes that are not listed in the current QPL, the Contractor
40 shall submit test information and the calculations used in the determination of T_{al}
41 performed in accordance with WSDOT Standard Practice T925 to the State Materials
42 Laboratory in Tumwater for evaluation. The Contracting Agency will require up to 30
43 calendar days after receipt of the information to complete the evaluation.

44 45 **9-33.4(3) Acceptance Samples**

46 Samples will be randomly taken by the Engineer at the job site to confirm that the
47 geosynthetic meets the property values specified.

48
49 Approval will be based on testing of samples from each lot. All "lot" shall be defined for
50 the purposes of this specification as all geosynthetic rolls within the consignment (i.e.,
51 all rolls sent the project site) that were produced by the same manufacturer during a
52 continuous period of production at the same manufacturing plant and have the same

product name. After the samples have arrived at the State Materials Laboratory in Tumwater, a maximum of 14 calendar days will be required for this testing.

If the results of the testing show that a geosynthetic lot, as defined, does not meet the properties required for the specified use as indicated in Tables 1 through 8 in Section 9-33.2, and additional tables as specified in the Special Provisions, the roll or rolls which were sampled will be rejected. Geogrids and geotextiles for temporary geosynthetic retaining walls shall meet the requirements of Table 7, and Table 10 in the Special Provisions. Geogrids and geotextiles for permanent geosynthetic retaining wall shall meet the requirements of Table 7, and Table 9 in the Special Provisions, and both geotextile and geogrid acceptance testing shall meet the required ultimate tensile strength T_{ult} as provided in the current QPL for the selected product(s). If the selected product(s) are not listed in the current QPL, the result of the testing for T_{ult} shall be greater than or equal to T_{ult} as determined from the product data submitted and approved by the State Materials Laboratory during source approval.

Two additional rolls for each roll tested which failed from the lot previously tested will then be selected at random by the Engineer for sampling and retesting. If the retesting shows that any of the additional rolls tested do not meet the required properties, the entire lot will be rejected. If the test results from all the rolls retested meet the required properties, the entire lot minus the roll(s) that failed will be accepted. All geosynthetic that has defects, deterioration, or damage, as determined by the Engineer, will also be rejected. All rejected geosynthetic shall be replaced at no additional expense to the Contracting Agency.

9-33.4(4) Acceptance by Certificate of Compliance

When the quantities of geosynthetic proposed for use in each geosynthetic application are less than or equal to the following amounts, acceptance shall be by Manufacturer's Certificate of Compliance:

Application	Geotextile Quantity
Underground Drainage	600 sq. yards
Soil Stabilization and Separation	1,800 sq. yards
Permanent Erosion Control	1,200 sq. yards
Temporary Silt Fence	All quantities
Temp. or Perm. Geosynthetic Retaining Wall	Not required
Prefabricated Drainage Mat	All quantities

The Manufacturer's Certificate of Compliance shall include the following information about each geosynthetic roll to be used:

Manufacturer's name and current address,
Full product name,
Geosynthetic structure, including fiber/yarn type,
Polymer type (for all temporary and permanent geosynthetic retaining walls only),
Geosynthetic roll number,
Proposed geosynthetic use(s), and
Certified test results.

9-33.4(5) Approval of Seams

If the geotextile seams are to be sewn in the field, the Contractor shall provide a section of sewn seam which can be sampled by the Engineer before the geotextile is installed.

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2 The seam sewn for sampling shall be sewn using the same equipment and procedures as
3 will be used to sew the production seams. If production seams will be sewn in both the
4 machine and cross-machine directions, the Contractor must provide sewn seams for
5 sampling which are oriented in both the machine and cross-machine directions. The seams
6 sewn for sampling must be at least 2 yards in length in each geotextile direction. If the
7 seams are sewn in the factory, the Engineer will obtain samples of the factory seam at
8 random from any of the rolls to be used. The seam assembly description shall be submitted
9 by the Contractor to the Engineer and will be included with the seam sample obtained for
10 testing. This description shall include the seam type, stitch type, sewing thread type(s), and
11 stitch density.